Third Space Endoscopy

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Preface

In 2008, Dr. Haruhiro Inoue performed the first PerOral Endoscopic Myotomy (POEM) on a human patient. This leap from animal models catapulted the field of advanced endoscopy into a novel, vast, and completely unknown territory. Access to a location between the intra- and extraluminal space razed the anatomical limitations of contemporary surgical treatments. Since its widespread adoption, POEM has changed the treatment algorithm of not just achalasia but numerous disorders affecting the gastrointestinal tract. These methods and techniques disseminated beyond benign disease and have solidly established a major role in numerous malignant conditions as well.

The text is organized into sections, exploring advanced endoscopic procedures with an emphasis on Third Space Endoscopy. These sections include Tissue Resection, Intentional Scar Formation, and Muscle Division. The authors are widely known and respected leaders in their respective fields. The chapters maintain an emphasis on procedural details, assisted by detailed diagrams and operative pictures.

We intend this book for both beginners and experts in the field, looking to augment their understanding and expertise of Third Space Endoscopy.

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Contents

Part III Muscle Division

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Chapter 1
History of Third Space Endoscopy

Joshua S. Winder

Introduction

Endoscopy has revolutionized surgery by offering minimally invasive techniques that improve patient outcomes and reduce recovery times. Among these advancements, third space endoscopy has emerged as a groundbreaking innovation, particularly in the field of submucosal endoscopic surgery (SES). This technique provides access to previously challenging anatomical areas, opening new possibilities for treating various gastrointestinal conditions. This chapter delves into the evolution of endoscopic surgery, the pivotal role of third space endoscopy, and its applications in SES.

A Brief History of Endoscopic Surgery

Early Beginnings

The concept of endoscopy dates back to the early nineteenth century when physicians first sought ways to explore the body's internal structures without the need for large incisions. In 1806, Philipp Bozzini, a German physician, developed the "Lichtleiter" (light conductor), a crude device used to examine the bladder [1, 2]. This rudimentary tool marked the dawn of endoscopic technology. The term "endoscope" is derived from the Greek words "endon" (inside) and "skopein" (to look),

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reflecting the core idea behind this approach. Despite its limitations, Bozzini's invention laid the groundwork for modern endoscopic tools [1].

Over the years, advances in light sources and optics gradually improved the practicality of endoscopy. By the early twentieth century, physicians were experimenting with flexible tubes and illumination techniques to peer into the human body [2]. Yet, significant challenges remained, particularly in terms of visualization and maneuverability.

Advancements in Technology

The twentieth century brought substantial progress in endoscopic technology. One of the most important breakthroughs came with the introduction of fiber optics in the 1950s, which drastically improved visualization inside the body [2, 3]. Fiber optics allowed light to be transmitted effectively into the body while enabling physicians to view internal structures more clearly. This revolutionized endoscopic procedures, giving rise to specialized scopes for different regions of the body, such as the gastrointestinal tract, bronchi, and abdomen. Instruments like the gastrointestinal endoscope, bronchoscope, and laparoscopy tools expanded the scope of endoscopic applications [3].

By the 1980s, endoscopic surgery began gaining traction as a minimally invasive alternative to traditional open surgery [2, 3]. Procedures like laparoscopic cholecystectomy, the removal of the gallbladder using small incisions and cameras, showcased the potential of these techniques. Minimally invasive surgery offered reduced recovery times, less postoperative pain, and shorter hospital stays, paving the way for widespread adoption across multiple surgical disciplines.

Emergence of Therapeutic Endoscopy

As endoscopy became more sophisticated, it transitioned from purely diagnostic purposes to therapeutic interventions [3]. Endoscopic techniques were developed for various gastrointestinal conditions, such as polypectomy, stenting, and the management of gastrointestinal bleeding. Endoscopic retrograde cholangiopancreatography (ERCP) and endoscopic mucosal resection (EMR) exemplify how endoscopy can be employed for both diagnosis and treatment.

Endoscopic techniques began to reduce the need for open surgeries, as patients benefited from less invasive methods. With innovations like stenting, dilation, and the management of gastrointestinal bleeding, endoscopy became a cornerstone of both diagnostic and therapeutic approaches, transforming the landscape of gastrointestinal surgery.

The Rise of Natural Orifice Transluminal Endoscopy Surgery (NOTES)

Emergence of Therapeutic Endoscopy

As endoscopy became more sophisticated, it transitioned from purely diagnostic purposes to therapeutic interventions. Endoscopic techniques were developed for various gastrointestinal conditions, such as polypectomy, stenting, and the management of gastrointestinal bleeding. ERCP and EMR exemplify how endoscopy can be employed for both diagnosis and treatment, reducing the need for invasive surgical interventions [4, 5]. Among these advancements, a significant experimental innovation that pushes the boundaries of minimally invasive techniques is natural orifice transluminal endoscopic surgery (NOTES).

NOTES and the Minimization of Surgical Trauma

The history of accessing the abdominal cavity for diagnostic and therapeutic purposes has evolved significantly over time. Traditional approaches, such as laparotomy, required large incisions to expose the area, but the introduction of minimally invasive laparoscopic techniques marked a major shift in reducing the morbidity associated with surgeries. Despite the advantages, laparoscopic surgery still carries risks like wound infections, hernias, and postsurgical pain due to skin incisions. To address these complications, *natural orifice transluminal endoscopic surgery (NOTES)* has emerged as a groundbreaking alternative, utilizing natural orifices like the mouth, anus, or vagina to access the abdominal cavity without external incisions [4, 5].

NOTES eliminates the need for external abdominal incisions, reducing complications such as surgical site infections (SSIs) and hernias that often arise from traditional surgical methods [4]. This technique reflects the culmination of centuries of endoscopic innovation, starting with Bozzini's invention of the rigid endoscope in 1805 and evolving through multiple technological advancements, including the fiber optic endoscope in the mid-twentieth century [2, 3, 5]. By enabling incisionless surgeries, NOTES provides distinct advantages in reducing adhesions and minimizing recovery time. Furthermore, it offers benefits for special populations, such as children and the morbidly obese, who may be more vulnerable to the complications of traditional surgery.

Challenges and Future Prospects of NOTES

Despite its potential, significant challenges hindered the widespread adoption of NOTES in human clinical practice. Technical difficulties, such as ensuring safe viscerotomy closure, improving the articulation of endoscopic devices, and managing contamination risks from nonsterile orifices, were a few of the many obstacles [5–7]. The development of specialized instruments and stronger collaboration between gastroenterology and surgical fields are critical to overcoming these challenges. Professional organizations, such as the Natural Orifice Surgery Consortium for Assessment and Research (NOSCAR), played a crucial role in advancing research and addressing both technical and societal aspects of this evolving field [5–7].

Although NOTES never took off as the paradigm-shifting surgical platform that many predicted, many of the principles and techniques that were developed and perfected as a result have translated into other areas of endoscopic surgery.

The Rise of Submucosal Endoscopic Surgery

Defining Submucosal Endoscopic Surgery

Submucosal endoscopic surgery (SES) refers to a subset of endoscopic procedures that target lesions located beneath the mucosal layer of the gastrointestinal tract. This approach enables the removal of submucosal tumors and lesions with minimal disruption to the surrounding tissue. SES techniques have gained prominence for their ability to provide effective treatment while minimizing complications and recovery time.

Historical Context and Development

The advent of SES can be traced back to the need for more effective methods of treating submucosal lesions, which were often challenging to access and remove using traditional endoscopic techniques [8, 9]. Early attempts at SES involved techniques such as needle knife dissection, which allowed for the resection of superficial lesions. However, these methods were limited by their potential for complications and suboptimal outcomes.

The introduction of endoscopic submucosal dissection (ESD) in the 1990s marked a significant milestone in SES [8]. Developed in Japan, ESD allowed for en bloc resection of larger lesions by dissecting the submucosal layer using specialized instruments. This technique offered greater precision and reduced recurrence rates compared to previous methods, thus garnering attention and adoption worldwide.

Transition to Third Space Endoscopy

Defining Third Space Endoscopy

Third space endoscopy refers to procedures that access the "third space," which is the anatomical area located between the mucosal and muscular layers of the gastrointestinal tract [8–10]. This innovative approach allows for greater access to submucosal structures, facilitating the treatment of a wide range of lesions and conditions.

The Conceptual Shift

The conceptual shift toward third space endoscopy emerged from the recognition of the limitations of traditional endoscopic techniques in accessing submucosal lesions. With the increasing complexity of gastrointestinal pathologies, there was a growing need for endoscopic approaches that could provide deeper access while minimizing surgical trauma.

The introduction of techniques such as peroral endoscopic myotomy (POEM) for treating achalasia highlighted the potential of third space endoscopy [9, 10]. By accessing the submucosal layer, surgeons could perform myotomy with minimal disruption to the surrounding tissue, resulting in shorter recovery times and fewer complications.

Key Innovations

Key innovations that facilitated the transition to third space endoscopy include:

1. Endoscopic ultrasound (EUS): The integration of EUS into endoscopic procedures allowed for precise localization of submucosal lesions, aiding in the planning and execution of third space surgeries.
2. Specialized instruments: The development of dedicated endoscopic instruments, such as the dual-channel endoscope and specialized dissection knives, provided the necessary tools for navigating and operating within the third space [5].
3. Training and techniques: The establishment of structured training programs and the sharing of techniques among practitioners contributed to the rapid adoption of third space endoscopy. Collaborative efforts through workshops and online resources helped standardize procedures and improve outcomes.